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ABSTRACT

This paper presents results of a study that sought to answer the question, "How does integrating dance and math in an intense co-teaching model of integration affect student attitudes toward learning math?" The goal of the dance/math project was to engage students in math in ways that reached students' multiple intelligences and encouraged them to make complex connections and try new problem solving techniques. The classroom teachers who designed and implemented the project hypothesized that students who worked with a dancer once a week to learn math concepts would become more engaged in mathematics and have more successful and positive experiences with mathematics than students who did not work with a dancer. Overall there was a significant difference between the dance/math students' and the non-dance/math students' attitudes toward mathematics. (MM)

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ARTS FOR ACADEMIC ACHIEVEMENT

Changing Student Attitudes Toward Math: Using Dance to Teach Math

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PREPARED FOR
The Minneapolis Public Schools

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Executive Summary

This paper describes results of a study that sought to answer the question, "How does integrating dance and math in an intense co-teaching model of integration affect student attitudes toward learning math?". The goal of the dance/math project was to engage students in math in ways that reached students' multiple intelligences and encouraged students to make complex connections and try new problem solving techniques. The classroom teachers, who designed and implemented the project, hypothesized that students who worked with a dancer once a week to learn math concepts would become more engaged in mathematics and have more successful and positive experiences with mathematics than students who did not work with a dancer.

A combination of classroom observations, student surveys, and teacher interviews were used to collect data about the dance/math project. The classroom observations were documented using Newmann, Secada, and Wehlage's (1995) Authentic Instruction rubric to assure that the treatment and comparison classrooms were equivalent in teaching quality. Ginsburg-Block and Fantuzzo's (1998) Academic Motivation Inventory (in math) was administered in both the fall and spring. The survey, made up of a three-point Likert scale, asked students to respond to 13 statements about math and math practices. All students in grades 2-5 (N= 202) completed a survey in the fall and then again in the spring. Finally teachers were interviewed both individually and as a group to explore possible reasons for attitudinal differences.

Overall, there was a significant difference between the dance/math students' and the non-dance/math students' attitudes toward math. On the motivation inventory post-test, dance/math students score significantly higher than their non-dance/math counterparts. Where the non-dance/math students became more negative or stayed the same, the dance/math students became more positive or stayed the same. Both groups of teachers asserted that dance/math students were more likely to be completely engaged in math and have more forms of expressing their mathematical knowledge than non-dance/math students. The dance/math teachers also stated that their students were better able to make connections among diverse subjects and pieces of knowledge than they were before the project, which made learning math more interesting and applicable to everyday life.

Whittier Community School for the Arts, a K-5 arts-focused school in the Whittier community of Minneapolis, completed its third year of an innovative arts integration project funded by the Minneapolis Arts for Academic Achievement/Annenberg Challenge Grant. This integration project was an intense partnership collaboration between individual classroom teachers and dance artists from the area that used concepts central to both math and dance to teach curriculum to students in grades 2-5. Six classroom teachers and three dancers worked together as a team and as individual teacher/artist pairs to create original dance/math curriculum and then to co-teach dance/math lessons once a week for the entire school year.

The goal of the dance/math project was to engage students in math in ways that reached students' multiple intelligences and encouraged students to make complex connections and try new problem solving techniques. The classroom teachers who designed and implemented the project hypothesized that students who worked with a dancer once a week to learn math concepts would become more engaged in mathematics and have more successful and positive experiences with mathematics than students who did not work with a dancer.

Data Collection

An outside researcher from the Center for Applied Research and Educational Improvement, at the University of Minnesota, administered an attitude toward math survey (see Ginsburg-Block & Fantuzzo, 1998) in both the fall and spring of the 2000-2001 school year. The survey, made up of a three-point Likert scale, asked students to respond to 13 statements about math and math practices. All students in grades 2-5 completed a survey in the fall (2000) and then again in the spring (2001). Table 1 shows the number of students per classroom and the grade levels involved in the study.

As Table 1 indicates, both dance/math and non-dance/math classrooms spanned from grades 2-5. However, due to looping[1] and class size needs, many dance/math classrooms were in the second grade during the 2000-2001 school year.

It is important to note that because the dance/math project formally began at Whittier during the 1998-1999 school year, some of the 3rd, 4th, and 5th grade students in the non-dance math classrooms during the study year (2000-2001) may have been in dance/math classrooms in the preceding years. In addition, some students within the dance/math classrooms in this study may have received more than one year of dance/math instruction.

[1] A school program that allows a teacher to remain with the same group of students over multiple years of instruction.

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In addition, one fourth grade classroom could not be included in the study because the teacher had been a part of the dance/math project for the previous two years, but was not part of the project for the third year (2000-2001). Because the teacher had had two years of integrating dance/math, her class could not be considered a comparison classroom. On the other hand, because she would not be working with an artist to integrate math during the third year, this classroom could not be included as a dance/math class either, and was, therefore, left out of the study.

Table 1. Classrooms Included in the Study

Dance/Math Classrooms				*Non-Dance/Math Classrooms*			
Classroom Code	*Number of students*	*Grade*	*Mean Score on Fall Survey*	*Classroom Code*	*Number of students*	*Grade*	*Mean Score on Fall Survey*
(A)	12	2	2.32	(AA)	13	2	2.34
(B)	16	2	2.46	(EE)	21	3	2.43
(C)	17	2	2.70	(FF)	27	4	2.31
(D)	22	3	2.60	(GG)	20	5	2.31
(E)	26	3	2.43	(HH)	22	5	2.56
(G)	19	5	2.43				

Data Analysis

The data were analyzed using a statistical software package (SPSS) in three ways: 1) An independent t-test comparing the dance/math group with the non-dance/math group as a whole; 2) Independent t-tests comparing individual dance/math classrooms with comparisons non-dance/math classrooms; and 3) Paired-sample t-tests comparing the student change from fall to spring within individual dance/math and non-dance/math classrooms.

One level of analysis required pairing dance/math classrooms with non-dance/math classrooms to most accurately see changes from the fall to the spring. In order to create these comparison pairs, a participating dance/math classroom was matched with the most similar non-dance/math class possible. The criteria for these pairings were (in order of importance) grade level, mean score of the fall survey, similar interventions in other subject areas, and number of students. As a result, three dance/math and three non-dance/math classrooms were paired for analysis (See Table 2).

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Table 2. Comparison Classrooms

Dance/Math Classes				*Non-dance/Math Classes*			
Classroom Code	*Number of students*	*Grade*	*Mean Score on Fall Survey*	*Classroom Code*	*Number of students*	*Grade*	*Mean Score on Fall Survey*
(A)	12	2	2.32	(AA)	13	2	2.34
(E)	26	3	2.43	(EE)	21	3	2.43
(G)	19	5	2.43	(GG)	20	5	2.31

Results

Overall, there was a significant difference between the attitude toward math of the dance/math students and the non-dance/math students. In the fall, as large groups, there had been no significant differences between the two. An ANOVA was run to check for classroom effects using the pre-test data from the fall. The ANOVA indicated that there were no significant classroom effects in the fall ($F = 1.819$, $p \leq .06$). However, by the spring, the dance/math students scored significantly higher on the survey (see table 3) indicating that they had a more positive attitude toward and excitement for math than their non-dance/math counterparts.

Table 3. Independent t-Test comparing Dance/Math with Non-Dance/Math Classes

Survey	Groups	N	Mean	St. Dev	t-test	Significance
Fall Survey	**Dance Math**	112	2.49	.42	-1.82	.07
	Non-d/m	102	2.39	.40		
Spring Survey	**Dance Math**	115	2.53	.42	-4.23	.00*
	Non d/m	100	2.28	.44		

* Indicates a significant difference.

There were also significant differences among the three paired comparison classrooms. In two of the three pairs, the dance/math classrooms showed significantly higher scores in the spring than the non-dance/math classrooms even though they started out with similar mean scores in the fall(see Table 4). However, due to the small number of students in each classroom, it is often difficult to find significant changes on a three point Likert scale. For this reason, even though the third grade dance/math classroom (E) had a higher mean score than its comparison classroom (EE) in the spring, the differences were not significant.

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Table 4. Comparison Classrooms by Grade Level

	Survey	Classrooms	N	Mean	St. Dev	t-test	Significance
GRADE 2	*Fall Survey*	A (d/m)	12	2.32	.52	.12	.90
		AA (non-d/m)	13	2.34	.28		
	Spring Survey	A (d/m)	16	2.79	.25	-2.91	.01*
		AA (non-d/m)	13	2.50	.29		
GRADE 3	*Fall Survey*	E (d/m)	26	2.43	.45	-.003	.10
		EE (non-d/m)	20	2.43	.43		
	Spring Survey	E (d/m)	24	2.50	.45	-1.60	.12
		EE (non-d/m)	20	2.26	.40		
GRADE 5	*Fall Survey*	G (d/m)	19	2.43	.48	-.77	.44
		GG (non-d/m)	20	2.31	.48		
	Spring Survey	G (d/m)	17	2.60	.28	-.51	.00*
		GG (non-d/m)	17	1.98	.43		

*Indicates a significant difference

Within classroom comparisons of scores from the fall to the spring in dance/math classrooms indicated that scores either increased significantly or had no significant change. On the other hand, scores in the non-dance/math classrooms either decreased significantly or had no significant change from the fall to the spring.

Table 5. Mean Score Differences

Dance/Math Classrooms				*Non-dance/Math Classrooms*			
Classroom Code	*Grade*	*Mean Score Fall/ Spring*	*Significance*	*Classroom Code*	*Grade*	*Mean Score Fall/ Spring*	*Significance*
(A)	2	2.32 /2.85	.02*	(AA)	2	2.34/2.47	.67
(B)	2	2.46/ 2.34	.61	(EE)	3	2.43/2.22	.08
(C)	2	2.70/ 2.61	.32	(FF)	4	2.31/2.16	.03*
(D)	3	2.60/2.40	.08	(GG)	5	2.31/1.98	.01*
(E)	3	2.43/2.49	.27	(HH)	5	2.56/ 2.51	.37
(G)	5	2.43 /2.61	.25				

*Indicates a significant difference

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In addition to tests of statistical significance, effect sizes, which indicate the strength of the "treatment," were also calculated. The results show that the dance/math project had a large effect on student attitudes toward math. The effect sizes for the total group results and the comparison classroom results were calculated using Hedge's g_a which controls for the sample size and is more conservative than Cohen's d. Table 6 shows the effect sizes for the total group and classroom comparisons.

Table 6. Effect Sizes

Comparisons	Effect Size (Hedge's g_a)	Level of Effect Size
Total Group (D/M compared to Non-D/M)	0.58	Moderate to large effect size
Classrooms A and AA	1.05	Very large effect size
Classrooms E and EE	0.55	Moderate effect size
Classrooms G and GG	1.67	Very large effect size

Discussion

The innovative collaborative arts integration process at Whittier Community School for the Arts significantly changed student attitudes toward math during the 2000-2001 school year. On the fall pre-test survey, students from the dance/math classrooms scored the same as their non-dance/math counterparts on their attitude toward math. However, after having one year of dance/math, the dance/math students scored much higher than the non-dance/math students. In general, the dance/math students either stayed the same or increased their scores on the survey, whereas the non-dance/math students stayed the same or decreased their scores.

The literature surrounding student attitude toward learning suggests a strong link between positive attitudes and student achievement scores (Gottfried, 1990). Although, the math standardized achievement scores for these students are not yet available, this link will be examined in the near future for the dance/math and non-dance/math students.

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